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OPTICAL INFORMATION RECORDING MEDIUM AND METHOD FOR RECORDING ONTO THE MEDIUM
[Hikari joho kiroku baitai oyobi kono baitai ni taisuru kiroku houhou]

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(54) Optical Information Recording Medium and Method for Recording onto the Medium *

[CLAIMS]

[Claims]

[Claim 1] An optical information recording medium wherein on a transparent substrate, a sputter manufactured film is formed by the successive layers of a 1st dielectric layer, a phase change recording layer, and a 2nd dielectric layer, and with the materials of the 1st and 2nd dielectric layers being respectively ZnS and SiO2, AgaInbSbcTed is the composition for the materials of the phase change recording layer, and with respect to the composition AgaInbSbcTed, along with the addition of element Xe other than composition elements, with Ag and Ag alloys as a metal reflective layer, a 3rd dielectric layer is established comprising material other than sulfate between the 2nd dielectric layer and the metal reflective layer [provided that a, b, c, and d have the following formula relationships (1)-(4) and assuming r is c/(c +d), the following formula relation (5).]

$$0 < a \leqq 0.01 \quad (1)$$
$$0.03 \leqq b \leqq 0.10 \quad (2)$$
$$0.40 \leqq d \leqq 0.70 \quad (3)$$
$$a + b + c + d = 1 \quad (4)$$
$$0.60 \leqq r \leqq 0.85 \quad (5)$$

[Claim 2] The optical information record medium according to Claim 1 whose element Xe is germanium [however, an addition e shall have the relation of the following formula (6)].

* Paragraph numbers take place for the original pagination in the foreign text.

$0.005 \leqq e \leqq 0.07$ (6)

[Claim 3] The optical information record medium according to Claim 1 or 2 wherein the film parameter (the R1= 2nd dielectric layer thickness / 1st dielectric layer membrane thickness) of this 2nd dielectric layer to this 1st dielectric layer has the relation of the following formula (7).

$0.1 \leqq R1 \leqq 0.5$ (7)

[Claim 4] The optical information record medium according to Claims 1 to 3 whose thermal conductivity of the 3rd dielectric layer is larger than the thermal conductivity of the 2nd dielectric layer.

[Claim 5] The optical information record medium according to Claims 1 to 4 wherein the film parameter (the R2= 3rd dielectric layer thickness / 2nd dielectric layer membrane thickness) of the 3rd dielectric layer to the 2nd dielectric layer has the relation of the following formula (8).

$0.1 \leqq R2 \leqq 0.5$ (8)

[Claim 6] The optical information record medium according to Claims 1 to 5 whose materials of this 3rd dielectric layer is a mixture of metallic carbide or metallic carbide, a metallic oxide, or a metal nitride.

[Claim 7] The optical information record medium according to Claim 6 wherein the metal of the metallic oxide is Si, and the metal of the metal oxide or metal nitride is Si and Ti or Al.

[Claim 8] A recording method for an optical information recording medium suitable for recording optical information on optical information recording medium contained in any of the Claims 1-7 and with a recording pulse train which is comprised of a plurality of on pulses of emitted light waveforms from laser light and off pulses continuous with them, a recording method for the light information recording medium recording by changing the recording frequency continuously in response to the recording radial positions from inner peripheral to outer peripheral or from outer peripheral to inner peripheral and continuously assembling parts fixing with the same damping constant all the widths of the plurality of the on pulses and the parts multiplying a constant by the window width.

[0009] A recording method for optical information recording medium according to Claim 8 wherein recoding information on the optical information recording medium is by changing the length of recording marks forming amorphous parts generated by irradiating LD within crystals of the recording layer, and the length of the recording mark controls by a fixed number of the recording pulse train (n + 1) (provided, n is an integer from 1 to 13), and the (n + 1)falling pulse positions X which from the 2nd pulse train to the 14th pulse train for every pulse train used randomly, when recording at the same recording rate, normally, during every base clock width, rises at the same position.

[Claim 10] A recording method for optical information recording medium contained in Claim 8 or Claim 9 which rises with a high damping constant from other n = 2-13 within the basic clock width only when n = 1, within the pulse train of n = 1-13.

[Detailed Description of the Invention]

[0001] [Field of the Invention]

This invention is related to optical information recording medium and to a recording method for this medium, and more specifically, to a recording method for phase changing optical information recording medium which can record, reproduce and write information and its medium.

[0002] [Prior Art]

Considering one of the optical information recording medium which can record, reproduce and erase information by irradiating laser beams, using the migration of crystal-amorphous interphase or crystal-crystal interphase, known as the so-called phase change optical information recording medium. This medium can be overwritten by a single beam, and is characterized by the simplicity of its drive-side optical system, used for recording medium on computers and for movies and sound.

[0003] As the recording material, GeTe, GeTeSe, GeTeS, GeSeS, GeSeSb, GeAsSe, InTe, SeTe, SeAs, germanium-Te- (Sn, Au, Pd), GeTeSeSb, GeTeSb, Ag-In-Sb-Te, etc. are used. Among these, especially Ag-In-Sb-Te has a clear profile of an amorphous part with high

sensitivity, and the presentation is disclosed by JP8-22644A compared with conventional materials as an optical information record medium which can attain the improvement in C/N, erasable ratio, sensitivity, and recording erasable property.

[0004] The configuration elements of this recording layer are mainly Ag, In, Sb, and Te, and each ratio α, ∃, γ, and δ (atomic %) has the following relation.

$$0<\alpha\leqq 30$$
$$0<\beta\leqq 30$$
$$10\leqq\gamma\leqq 50$$
$$10\leqq\delta\leqq 80$$
$$\alpha+\beta+\gamma+\delta=100$$

[0005] In the record method the revolution linear velocity of a disk performs recording and erasure in the range of 1.2 m/s to 5.6 m/s. This method is especially applied to a rewritable compact disk (CD) using the material system as an optimal optical information record medium, the configuration elements of the recording layer of the medium are mainly Ag, In, Te, and Sb, and the optical information record medium with which each composition ratio α, ∃, γ, and δ (atomic %) has the relation of the following type as disclosed by JP H9-263055A.

$$1\leqq\alpha<6$$
$$7\leqq\beta\leqq 20$$
$$20\leqq\gamma\leqq 35$$
$$35\leqq\delta\leqq 70$$
$$\alpha+\beta+\gamma+\delta=100$$

[0006] With the current optical disk, DVD-ROMs of 4.7GB capacity are already commercialized, and high recording density media, such as DVD-RW, are proposed as an optical information record medium with high compatibility to current disk and with comparable capacity. Since the disk rotational frequency of a DVD-ROM is 3.49 m/s, even if the recording materials used for this and a uniform optical information recording medium is a composition disclosed presentation by JP H9-263055A, the medium is appropriate. However, it became clear by experiment for implementation of the recording medium which has the high density recording of DVD-ROMs with this capacity, that gaining recording linear velocities of 2X or more (about 7 or more m/s) would be difficult.

[0007] [Problems to be Solved by the Invention]

This invention is a writing type information recording medium with the same capacity as DVD-ROM, having good recording properties when recording at high linear velocities and along with providing an optical information recording medium which is superior in preserving stability, provides a recording method for this medium.

[0008] [Means for Solving the Problems]

The inventors, in order to solve the previously described problems, focused wholeheartedly on producing recording layers with metal and dielectric layers with metallic reflective layers.

[0009] This invention is an optical information recording medium wherein on a transparent substrate, a sputter manufactured film is

formed by the successive layers of a 1st dielectric layer, a phase change recording layer, and a 2nd dielectric layer, and with the materials of the 1st and 2nd dielectric layers being respectively ZnS and SiO2, AgaInbSbcTed is the composition for the materials of the phase change recording layer, and with respect to the composition AgaInbSbcTed, along with the addition of element Xe other than composition elements, with Ag and Ag alloys as a metal reflective layer, a 3rd dielectric layer is established comprising material other than sulfate between the 2nd dielectric layer and the metal reflective layer [provided that a, b, c, and d have the following formula relationships (1)-(4) and assuming r is c/(c +d), the following formula relation (5).]

$$0 < a \leq 0.01 \quad (1)$$
$$0.03 \leq b \leq 0.10 \quad (2)$$
$$0.40 \leq d \leq 0.70 \quad (3)$$
$$a+b+c+d=1 \quad (4)$$
$$0.60 \leq r \leq 0.85 \quad (5)$$

[0010] The optical information record medium according to Claim 1 whose element Xe is germanium [however, an addition e shall have the relation of the following formula (6)].

$$0.005 \leq e \leq 0.07 \quad (6)$$

[0011] The optical information record medium according wherein the film parameter (the R1= 2nd dielectric layer thickness / 1st dielectric layer membrane thickness) of this 2nd dielectric layer to this 1st dielectric layer has the relation of the following formula (7).

$0.1 \leqq R1 \leqq 0.5 \quad (7)$

[0012] The optical information record medium whose thermal conductivity of the 3rd dielectric layer is larger than the thermal conductivity of the 2nd dielectric layer.

[0013] The optical information record medium wherein the film parameter (the R2= 3rd dielectric layer thickness / 2nd dielectric layer membrane thickness) of the 3rd dielectric layer to the 2nd dielectric layer has the relation of the following formula (8).

$0.1 \leqq R2 \leqq 0.5 \quad (8)$

[0014] Further, the metal of the optical information record medium whose ingredient of this 3rd dielectric layer is mixture with metallic carbide or metallic carbide, a metallic oxide, or a metal nitride, and this metallic carbide is Si, and the optical information recording medium whose metal of this metallic oxide or a metal nitride is Si, Ti, or aluminum as contained in this 1st invention.

[0015] According to this invention, as a 2nd invention the recording method for an optical information recording medium suitable for recording optical information on optical information recording medium with a recording pulse train which is comprised of a plurality of on pulses of emitted light waveforms from laser light and off pulses continuous with them, a recording method for the light information recording medium recording by changing the recording frequency continuously in response to the recording radial positions from inner peripheral to outer peripheral or from outer peripheral to

inner peripheral and continuously assembling parts fixing with the same damping constant all the widths of the plurality of the on pulses and the parts multiplying a constant by the window width.

[0016] In this 2nd invention, the invention is a recording method for optical information recording medium wherein recoding information on the optical information recording medium is by changing the length of recording marks forming amorphous parts generated by irradiating LD within crystals of the recording layer, and the length of the recording mark controls by a fixed number of the recording pulse train (n + 1) (provided, n is an integer from 1 to 13), and the (n + 1)falling pulse positions X which from the 2nd pulse train to the 14th pulse train for every pulse train used randomly, when recording at the same recording rate, normally, during every base clock width, rises at the same position.

[0017] This 2nd invention is a recording method for optical information recording medium contained in Claim 8 or Claim 9 which rises with a high damping constant from other n = 2-13 within the basic clock width only when n = 1, within the pulse train of n = 1-13.

[0018] [Embodiments]

Generally the recording materials used are compositions close to the compound Ge2Sb2Te5 for high density recording, the recording materials which are used have principal components expressed by AgInSbTe, and the latter material is used for CD-RW, very popular having been commercialized with good erasure properties when

overwriting for high density recording. Compositions related to recording materials of the AgInSbTe series are disclosed in JP H8-22644A and H8-263871A. Furthermore, recently, DVD-RW mediums have been commercialized that are capable of high density recording at 4.7GB, a recording density that can be used for video.

[0019] This erasable optical disk is DVD-ROM and many products have already been commercialized using as recording materials AgInSbTe series materials which are suitable for recording applications at high densities. It is expected that in the future that development of optical disks with high linear velocities will be possible.

[0020] As a composition in which, using AgInSbTe series materials high linear velocity is possible, the inventors have proposed a composition with a reduced Ag content (JP H11-153316A). Even with this recording composition, although using a DVD-ROM at 1-2.5X was possible, the characteristics of writing, preservation, and over-writing were not sufficient.

[0021] In order to solve these problems, as a result of repeated research, experiments were performed with added germanium content giving a recording layer in which the preservation dependability problem was solved. Although JP H8-263871A disclosed that germanium could be added to AgInbTe with resulting improved dependability, having a recoding linear velocity reaching 2.5X with DVD-ROMs, there have been few additions of Sb, though the Ge addition could be

confirmed by experiment to have at the same time faults which reduced the disk's modulation degree.

[0022] The modulation reduction problem can be solved by making the reflective layer one of Ag or Ag alloy, and furthermore, when using Ag or Ag alloy in the reflecting layer, because conventional ZnS-SiO2 upper preservation layers are in contact with Ag or Ag allows, from the flow of Ag, good recording properties are not obtained, and in order to prevent such poor results, it was confirmed that it was effective to mix Si carbide or nitride and oxide dielectrics with them between the ZnS-SiO2 and reflecting layer.

[0023] Consequently, in composed in this fashion, improvements are found in permissible values for writing power in order to obtain good recording characteristics between different drives or over-write characteristics. In addition, when carrying out a drive design for the purpose of low power expenditure, if the CAV method which records by fixing the rotational frequency of a motor is adopted, but if a recording medium sets the inner circumference section to 1 in this case, for the same outermost periphery of a disk with a diameter of 120mm as CD-RW, the resulting velocity will become 1-2.5X. Although the result with the above-mentioned good medium structure realizes a recording medium corresponding to 1-2.5X the linear velocity, it becomes possible by devising recording strategy to aim at recording characteristic improvement. In order to make a recording

characteristic of 1-2.5X the linear velocity, recording strategy adjustments adjustment become important.

[0024] Although the applicant has proposed strategies effective in recording to CAV with recordings mediums of SbTe + M made into 4 laminations using aluminum reflective film (JP H11-31926A), the effectiveness of this method was investigated and used to good effect to prove recording improvements.

[0025] Accordingly, this invention is an optical information recording medium wherein on a transparent substrate, a sputter manufactured film is formed by the successive layers of a 1st dielectric layer, a phase change recording layer, and a 2nd dielectric layer, and with the materials of the 1st and 2nd dielectric layers being respectively ZnS and SiO2, AgaInbSbcTed is the composition for the materials of the phase change recording layer, and with respect to the composition AgaInbSbcTed, along with the addition of element Xe other than composition elements, with Ag and Ag alloys as a metal reflective layer, a 3rd dielectric layer is established comprising material other than sulfate between the 2nd dielectric layer and the metal reflective layer [provided that a, b, c, and d have the following formula relationships (1)-(4) and assuming r is c/(c +d), the following formula relation (5).]

$$0 < a \leq 0.01 \quad (1)$$
$$0.03 \leq b \leq 0.10 \quad (2)$$
$$0.40 \leq d \leq 0.70 \quad (3)$$
$$a + b + c + d = 1 \quad (4)$$
$$0.60 \leq r \leq 0.85 \quad (5)$$

(0035

[0026] The relationships in above-mentioned formulae (1) - (4) and (5), when (1) exceeds this range, the optical recording medium which is used for CAV recording, especially at a high linear recording speed, invites a degradation in fundamental properties such as the degree of modulation. When there is absolutely no addition, stability is poorly preserved. When (2) exceeds its range, the amorphous marks become crystallized with reading of the drive, with significant concern that the shape of the recording medium marks will be damaged, and when (2) is not in the range, the required degree of modulation is difficult to achieve, generating degradation from reproduction jitters as a result. When (3) exceeds the range, the optical information recording medium which is used for CAV recording in the same way as with (1), especially under conditions of high linear velocity, degradation in basic properties occurs such as jitter, reflectance, and modulation degree, and when too small, because problems develop from the worsening of preservation stability, this range is undesirable.

[0027] As for the above-mentioned element Xe, it is desirable that it be germanium. [provided that the addition e shall have the relation(6)]

$$0.005 \leqq e \leqq 0.07 \quad (6)$$

When this addition has too much e in the above-mentioned formula (6), when recording at high linear velocity, degradation of fundamental properties, such as a jitter, a reflectance, and modulation degree,

is caused, and since preservation stability gets worse when e is too small, values in that range are not desirable.

[0028] Moreover, it is desirable that the film parameter (the R1= 2nd dielectric layer thickness / 1st dielectric layer membrane thickness) of the 2nd dielectric layer to the 1st dielectric layer of the above has the following relation (7).

$$0.1 \leq R1 \leq 0.5 \quad (7)$$

[0029] Moreover, if it is the optical information record medium of this invention, it is desirable that the thermal conductivity of the 3rd dielectric layer is larger than the thermal conductivity of the 2nd dielectric layer. This is because the amorphous mark by which the relationship of the above-mentioned thickness and the thermal conductivity of this 3rd dielectric layer are stabilized during high linear velocity recording by emitting efficiently the heat generated by absorbing LD light by the recording layer being larger than that of the 2nd dielectric layer so that a reflective heat dissipation layer will be obtained.

[0030] Furthermore, it is desirable that the film parameter (the R2= 3rd dielectric layer thickness / 2nd dielectric layer film thickness) of the 3rd dielectric layer of the above to the 2nd dielectric layer of the above has the relation of the following (8).

$$0.1 \leq R2 \leq 0.5 \quad (8)$$

[0031] Moreover, the metal of the 3rd dielectric layer is a mixture with metallic carbide or metallic carbide, a metallic oxide, or a metal nitride and the metallic carbide is Si, and it is desirable that the metal of a metallic oxide or a metal nitride is Si, Ti, or aluminum. When the metal of the metal of metallic carbide is Si, a metallic oxide, or a metal nitride is Si or aluminum, from point of view of film homogeneity, the thermal conductivity will be good.

[0032] This invention is appropriate for the 2nd recording optical information on the above-mentioned optical information record medium. The luminescence wave of laser light is made into a record pulse train which consists of two or more on-pulses and a following off pulse. It is the recording method for the optical information recording medium in which recording frequency is changed to a periphery or inner circumference from a periphery, and recording continuously from the inner circumference corresponding to a recording radius location. The recording method for the optical information recording medium is characterized by combining continuously the part which fixes all of the width of two or more of these on-pulses with the same time constant, and the part which carries out multiplication of the constant by the window width.

[0033] In this recording method, as shown in Fig. 2, a good jitter property can be acquired by adjusting the pulse width in each reference clock of x(n+1) Tw, so that the falling location of each

pulse train may be at the same location for a reference clock, respectively at the time of record with the same linear velocity. However, n is an integer of 1-13. This width has the desirable range of 0.2-0.8 of the width of each reference clock. Since the part of an off pulse becomes too short too and sufficient delay decreases when exceeding the range expressed with the above-mentioned formula, a stable amorphous mark is not obtained, and conversely, sufficient heat for ON pulse width being too narrow, an amorphous mark, less than this range is not obtained.

[0034] Furthermore, with the recording method of this invention, the jitter property can be reduced by using a time constant which makes falling at the location of n = 1 earlier than that at n = 2-13. Under the present case, it is desirable that the falling location of n = 1(initial pulse) after the end of every pulse train for n = 2-13 is 0.01T-0.3T from the position after every pulse train of n = 2-13. By fixing the damping constant in this way, with amorphous marks of length from n = 1 to 13, it is possible to make variations of each mark's entire length small for every basic clock.

[0035] Hereafter, this invention is concretely explained. Fig. 1 is a schematic diagram of the optical recording medium structure of this invention. The optical information recording medium of this invention produces the 1st dielectric layer 2, the phase change recording layer 3, the 2nd dielectric layer 4 of a top protective layer, the 3rd dielectric layer, and a metallic reflective layer 6 as

a lower protective layer by the sputtering method on the polycarbonate substrate 1 which has a guide rail, and opposite substrate pasting is not needed, even if the laminating of each class which functions as a medium is carried out. A pressure sensitive adhesive sheet, radical ultraviolet-rays cured resin, cationic polymerization resin, etc., can be used for a glue line. Moreover, the laminating of the environmental protection layer 7 which consists of ultraviolet-rays cured resin applied by spin coating on the metallic reflective layer may be carried out.

[0036] As film production conditions for each class, the 1st and 2nd dielectric layer were set to 3kW of charge power, and Ar gas pressure (film production room atmospheric pressure) 2mTorr, phase change record was set to 1kW of the charge power, and Ar gas pressure (film production room atmospheric pressure) 2mTorr, the 3rd dielectric layer was set to 1kW of the charge power, and Ar gas pressure (film production room atmospheric pressure) 2mTorr, and the metallic reflective layer was taken as 9kW of the charge power, and Ar gas pressure (film production room atmospheric pressure) 2mTorr. The 1st and 2nd dielectric layer can be formed with various vapor growth methods, for example, vacuum evaporation technique, the sputtering method, electron beam vacuum deposition, etc.

[0037] The materials of each class are as follows. Germanium is added for a phase change recording layer to the conventional AgInSbTe. In order to obtain an optical disk of higher linear velocity, 1% or

less of the content of Ag is desirable as an atomic ratio. Moreover, germanium is used to improve preservation stability. Besides germanium, with AgInSbTe, if the crystallization rate rises lowering and crystallization temperature simultaneously, a good result can be obtained though Ga, Si, N, etc. will bring about the same effectiveness. However, it is necessary to limit this content to 7% or less, with 5% or less especially desirable for a high linear velocity optical disk.

[0038] The same mixed target of ZnS (80%) and SiO2 (20%) as the conventional example is used for the 1st and 2nd dielectric layer. Although this mixing ratio may be adjusted for adjustment of thermal conductivity, the mixing ratio of SiO2 has the desirable range which should not exceed 50%.

[0039] Although the mixture of SiC and SiO2 is used for the 3rd dielectric layer, thermal conductivity is higher than the 1st and 2nd dielectric layer, and the principal components should just be dielectric materials other than an oxide. 20% or less oxide content is desirable for the weight critical ratio.

[0040] The thickness has materials which use for a metallic reflective layer metals which are elements, such as Pd, In, Cu, Si, and germanium, or the mixture of those, and they serve as an eutectic with 10% Ag content and film thickness desirable at 60-200nm. Heat dissipation effectiveness is not acquired at less than 60nm. Moreover,

when a film layer is too thick, since it becomes easy to produce interfacial peeling, it is not desirable.

[0041] As for the film parameter R1= (the 2nd dielectric / the 1st dielectric) of the 1st dielectric layer and the 2nd dielectric layer, $0.1 \leqq R1 \leqq 0.5$ is desirable. When the 1st dielectric layer is too thin, since a substrate side is filled with the heat absorbed by the recording layer and the over-writing property gets worse with laser light when recording, it is not desirable.

[0042] As for the 3rd dielectric layer, what has high thermal conductivity is desirable with respect to the 2nd dielectric layer, and the following range of the film parameter R2= (the 3rd dielectric / the 2nd dielectric) is still more desirable.

$$0.1 \leqq R2 \leqq 0.5$$

When the 3rd dielectric layer is too thick, the heat absorbed by the recording layer at the time of recording radiates heat with laser light, the temperature rise of a recording layer becomes insufficient, and since lowering of recording sensitivity results, being too thick is not desirable.

[0043] Thus, by optimizing the thickness of the 1st, 2nd, and 3rd dielectric layers, a high linear velocity recording of DVD-ROM with 2.5X or more is attained, and an optical disk with a still better over-writing property can be realized.

[0044] Recording of the information on an optical information recording medium is performed by changing the die length of a record mark (the amorphous part produced by irradiating LD is formed during the crystallization of a recording layer). Controlling the die length of a record mark by the number of the record pulse train (n+1) indicated by Claim 8, n is the integer of 1-13. Although this becomes record strategy as shown in Fig. 2, only the first pulse comes to form a pulse using 2T parts of a clock, to a clock of 1T parts, one pulse starts and the others fall. By using this recording strategy, it becomes possible to form a recording mark of length 3-14 times that of the fundamental clock width Tw. The method of mark length modulation using a length of 3-14 times that of the clock width Tw is called EFM + modulation method and is a well-known recording modulation method.

[0045] Furthermore, the negative-going-pulse location X of each record pulse train (n+1, i.e., from 2 pulse trains to 14 pulse trains, is used at random) according to Claim 8. When recording with the same record linear velocity (the same Tw), the recording method that the die length changes to linear comparatively from the mark of the die length of 3xT to the mark of the die length of 14xT can always be realized by falling in the same location for each reference clock width. Although recording with good jitter properties can be obtained, by this invention, the linearity of the die length of the mark of 3T-

14T can be further raised by making only the back end of a top pulse shorter than the back end of other pulse trains.

[0046] Fig. 2 shows the pulse array for the recording strategy by the timing chart. Although the strategy specified for this invention was the same strategy and basic objective of JP H11-131926A, by using this strategy showed a flat jitter property was acquired for a recording characteristic with the linear velocity of 1-2.5X that of DVD-ROM with the recording medium of this invention.

[0047] Furthermore, as a result of experimenting for an optimum strategy, it was found effective to move only the pulse of the pulse train beginning to the front more nearly serially than with other consecutiveness pulses. This situation is shown in Fig. 3.

[0048] Table 1 investigates the repeat recording rate with a recording linear velocity of 8.5 m/s using the optical recording medium of this invention with comparative examples. The repeat recording count is determined by the maximum count which a jitter value sigma/Tw, normalized by the window width Tw which satisfies the normalized value. The track pitch is 0.74 micrometers.

[0049] [Embodiments]

Although embodiments are given below to explain in detail this invention, the invention is not limited by these embodiments.

[0050] Embodiment 1

For the optical information recording medium which forms a recording layer of compositions in Table 1, using a sputter method on

a poly carbonate substrate, use 70nm of a 1st dielectric layer using a mixture target of 20nm, ZnSSiO2, 15nm of a 2nd dielectric layer, 5nm of a 3rd dielectric layer using a mixture target of SiCSiO2, and 140nm of a metal reflecting layer which uses Ag-Pd alloy, and recording using a recording strategy shown in Claims 8 and 9, ? evaluate the recording properties and preservation stability. The preservation stability and jitter properties were evaluated by a preservation period which exceeds standard values under conditions of 85 °C and 85% RH.

[0051]Embodiment 2

Except for changing the recording layer composition the embodiment was made in the same as with Embodiment 1.

[0052] Embodiment 3

Recording was made with respect to the recording layer composition of Embodiment 1 with the recording strategy shown in Claim 10.

[0053] Embodiment 4

With a composition the same as Embodiment 2, the recording strategy of Claim 10 was used. Table 1 shows the results for Embodiments 1-4

[0054] Embodiment 5

Fig. 3 shows the results of CAV recording by using the recording strategies shown in Claims 8 and 9 and 10. At the same time, for comparison, results are shown of CAV recording using strategies which

were not fixed simultaneously by damping constants for parts which were fixed by the damping constant of Claim 8 and parts which multiplied constants by the window width Tw. By using the Claims 8 and 9 recording strategies, comparatively flat jitter properties were obtained from the inner periphery, and furthermore, by using the recording strategy of Claim 10, it was understood that the jitter properties improved. When CAV recording using a strategy where there were no parts simultaneously fixed by damping constants, it was understood that there was a remarkable increase in jitter at the low linear speeds. It was thought that this was because the strategy of having no parts which were simultaneously fixed by damping constant could narrow the pulses for low linear speeds.

[0055] Comparative Example 1

Considering AgInSbTe as the recording layer composition for Embodiment 1, the recording properties and preservation stability were evaluated.

[0056] Comparative Example 2

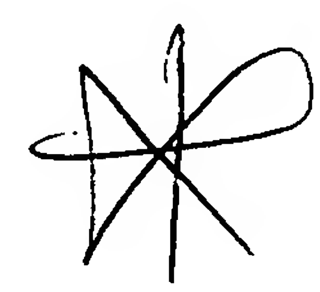
Except for changing the reflection layer material from Ag metal alloy to Al-Ti metal alloy for the layer formations of the recording layer in Embodiment 1, the preparation is the same as that in Embodiment 1 and the recording properties and preservation stability were evaluated.

[0057] Comparative Example 3

Recording was performed using a strategy with one less recording pulse trains than a recording strategy according to Claims 8 and 9 which corresponds to the recording layer constitution in Embodiment 1 . The entire length of the pulse train was adjusted so as to be equal to the recording strategy shown in Claims 8 and 9. For the recording linear speed which is suitable for DVD-ROM 1X, the recording strategies in Claims 8 and 9 become nearly equal in their results, but the recording properties for recording linear velocity at 2.5X was poor. Table 1 shows the results for Comparative Examples 1-3.

[0058] [Table 1]

	a) 記録層組成(原子%)					b) 反射層	c) 記録線速 (m/s)	d) ジッタ性	e) 変調度	f) 保存安定性
	[illegible]	In	Sb	Te	Ge					
g) 実施例1	0.5	6.0	68.5	23	2.0	Ag-Pd	8.5	8.5%	0.65	>500 時間 i)
実施例2	1	5.0	68.0	24	2.0	Ag-Pd	8.5	8.3%	0.68	>500 時間
実施例3	0.5	6.0	68.5	23	2.0	Ag-Pd	8.5	8.1%	0.66	>500 時間
実施例4	1	5.0	68.0	24	2.0	Ag-Pd	8.5	7.9%	0.69	>500 時間
h) 比較例1	0.5	6.0	69.5	24	0	Ag-Pd	8.5	8.4%	0.70	300 時間
比較例2	0.5	6.0	68.5	23	2.0	Al-Ti	8.5	8.7%	0.57	>500 時間
比較例3	0.5	6.0	69.5	24	0	Ag-Pd	8.5	9.6%	0.71	—



Key: a) Recording layer composition (atomic %); b) Reflecting layer; c) Recording linear speed (m/s); d) Jitter; e) Modulation; f) Stability preservation; g) Embodiment; h) Comparative example; i) hours.

[0059] [Effect of the Invention]

According to this invention, the invention is a writable optical information recording medium with the same capacity as that of DVD-ROM having good properties when recording at high linear speed, especially for modulation, as the invention provides a recording

method which improves preservation stability, over writing and archive life, making an extremely significant contribution to the optical information recording field.

[Brief Description of the Drawings]

[Figure 1] It is the sectional view of the optical information record medium of this invention.

[Figure 2] It is a drawing showing the pulse array of the record strategy by the timing chart.

[Figure 3] It is a drawing showing the elements of the record strategy.

[Explanation of Elements]

1 Substrate

2 1st Dielectric Layer

3 Recording Layer

4 2nd Dielectric Layer

5 3rd Dielectric Layer

6 Metallic Reflective Layer

7 Environmental Protection Layer

Figure 1

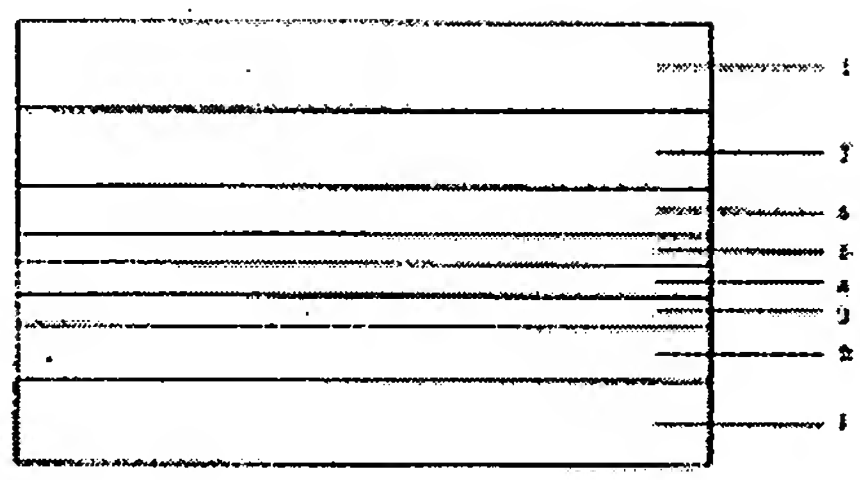
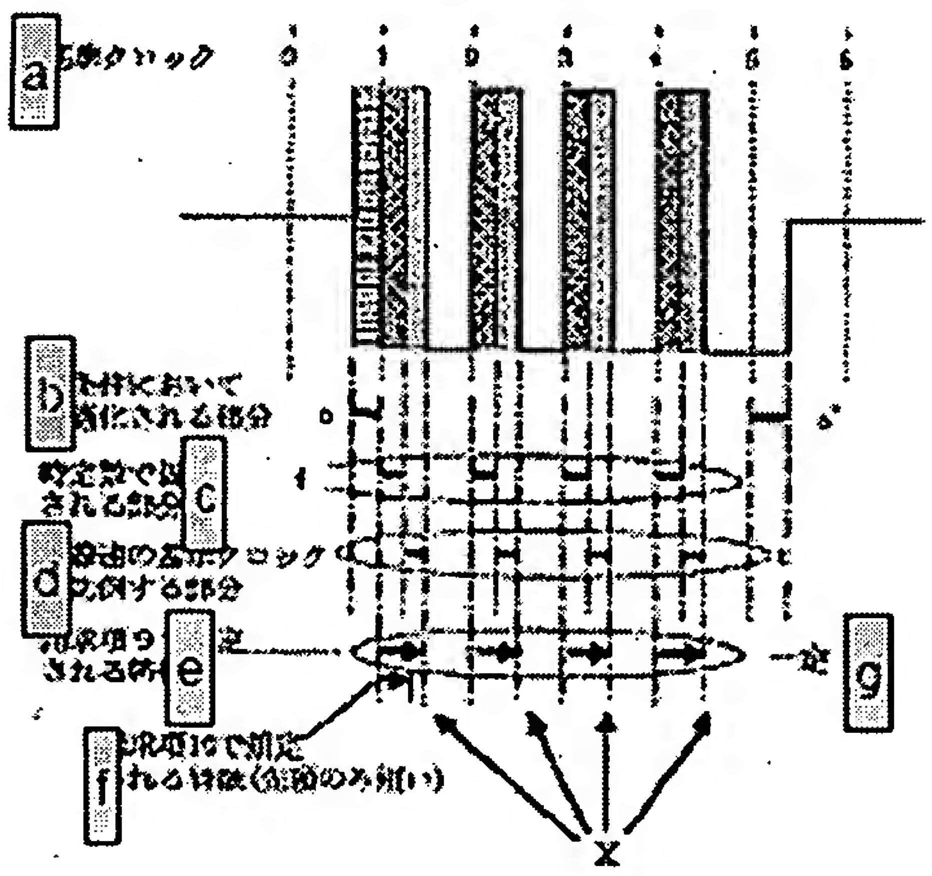
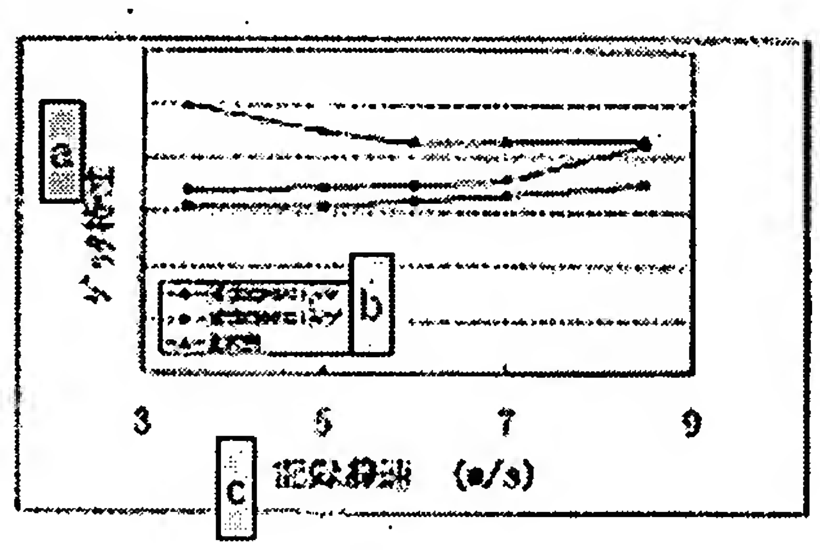


Figure 2



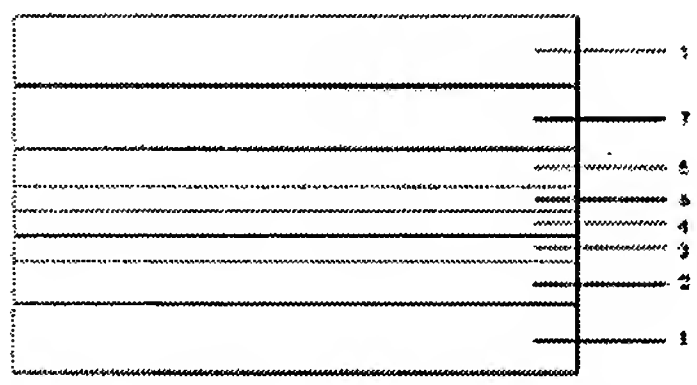
Key: a) Base clock; b) Part optimized for every conditions; c) Part fixed by damping constant; d) Part proportional to base clock for each linear speed; e) Properties realized by Claim 9; f) Properties realized by Claim 10 (narrowing only at head); g) Constant.

Figure 3

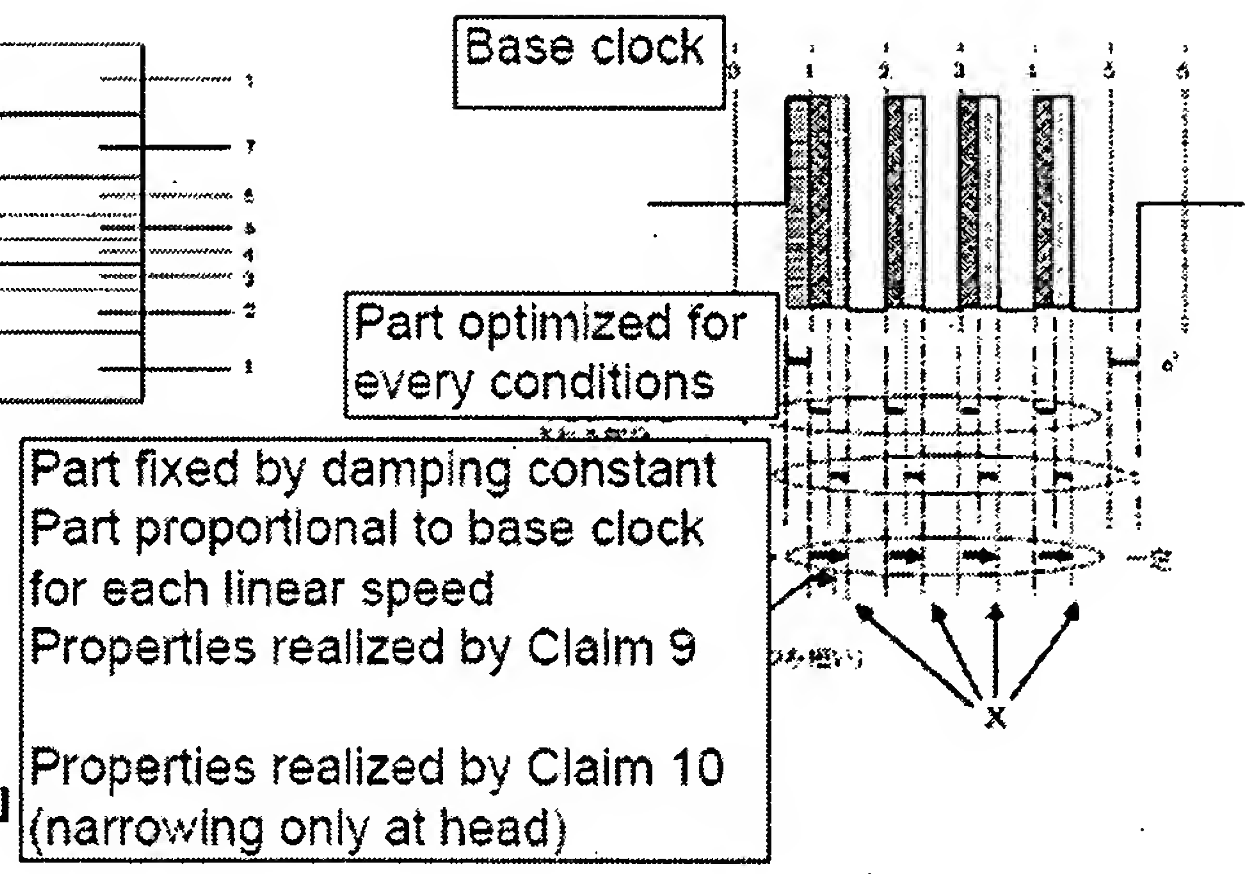


Key: a) Jitter properties; b) [illegible]; c) Recording linear speed.

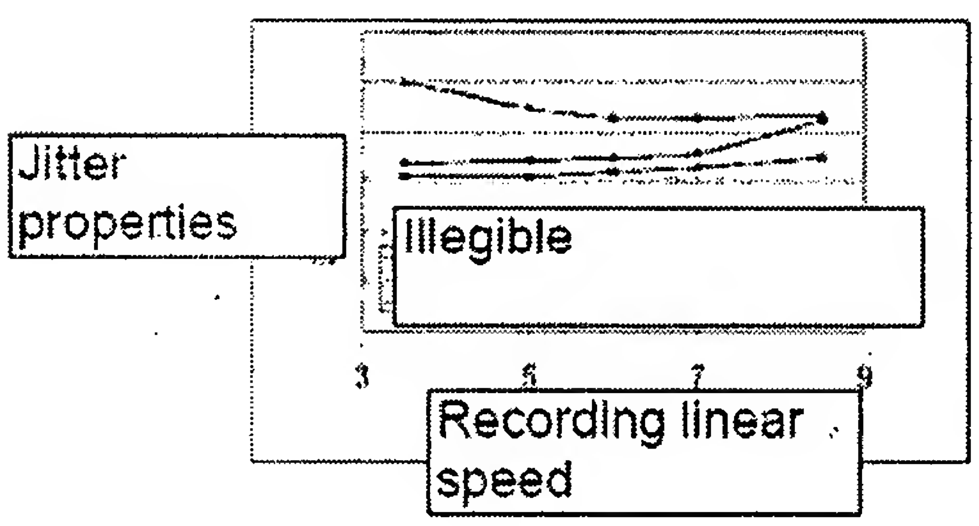
【図1】



【図2】


Base clock
Part optimized for every conditions
Part fixed by damping constant
Part proportional to base clock for each linear speed
Properties realized by Claim 9
Properties realized by Claim 10 (narrowing only at head)
X

【図3】


Jitter properties
Illegible
3
5
7
9
Recording linear speed